



(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 0112**Roll No. 

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**B.Tech.****(SEMESTER-IV) THEORY EXAMINATION, 2012-13****THEORY OF AUTOMATA & FORMAL LANGUAGES***Time : 3 Hours ]**[ Total Marks : 100***SECTION - A**

1. Attempt all question parts :

**10 × 2 = 20**

- (a) Draw the model diagram for finite automata and pushdown automata.
- (b) What is the role of finite automata for searching a keyword in documents ?
- (c) Write Regular Expression for the following languages :
- (i) Set of all strings such that the number of 0's is odd
- (ii) Set of all strings that do not contain 1101 as a substring
- (d) Design CFG for the language consisting of all strings of even length over  $\{a, b\}$ .
- (e) Briefly write about Church-Turing thesis with a neat diagram.
- (f) What is Moore and Mealy machine ?
- (g) Convert the given CFG into PDA by empty stack :

$$G: S \rightarrow AB \mid a$$

$$A \rightarrow SaS \mid \epsilon$$

$$B \rightarrow b$$

- (h) Define the languages generated by Turing Machine.
- (i) State whether the following instances of PCP has a solution. Justify.  
Top = (10, 011, 101) Bottom = (101, 11, 011)
- (j) Show that  $\phi^*$  is  $\in C$  by constructing its NFA using Thomson's method.



## SECTION - B

2. Attempt any **three** question parts :

**3 × 10 = 30**

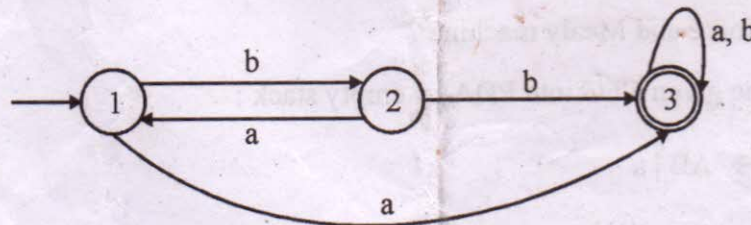
- (a) (i) Explain in detail about various models of Turing Machine.  
 (ii) State halting problem. Prove that "HALT<sub>TM</sub> is undecidable".
- (b) Convert the following given Non-deterministic finite automata into minimized Deterministic finite automata.

Given NFA :

States/Input	A	B
→p	{q, s}	{q}
*q	{r}	{q, r}
r	{s}	{p}
*s	-	{p}

- (c) Define Inference, Derivation and Syntax tree. Consider the context free grammar  $G: P \rightarrow 0P0 \mid 1P1 \mid \epsilon$  and build derivation, syntax tree and inference for the string 0110 using grammar G.
- (d) Construct Pushdown automata for the language  $L = \{ ww^R \mid w \text{ is in } (0 + 1)^* \}$ . Give instantaneous description of the input 1111.
- (e) Consider the following DFA and find its equivalent regular expression using Rij method.

Given DFA :



## SECTION - C

Attempt all questions :

**5 × 10 = 50**

3. Attempt any **two** parts :

**2 × 5 = 10**

- (a) Draw NFA-  $\epsilon$  transition diagram for the following regular expressions :
- (i)  $((ab)^*/b)a$   
 (ii)  $(0^* / 1^*)^*10$
- (b) Write an algorithm to minimize the given DFA using subset construction method.
- (c) Construct DFA that accepts set of natural numbers which are divisible by 3.

4. Attempt any **one** part :

1 × 10 = 10

- (a) State pumping lemma. Prove that the language consisting of “set of all strings over {a} whose length is prime” is not regular.
- (b) Illustrate in detail about all the closure properties of regular languages.

5. Attempt any **one** part :

1 × 10 = 10

- (a) Write down the steps required to convert CFG into Chomsky Normal Form. Consider the following CFG and find its equivalent CNF and GNF.

$$G: S \rightarrow ASB \mid \epsilon$$

$$A \rightarrow aAS \mid a$$

$$B \rightarrow SbS \mid A \mid bb$$

- (b) How to eliminate useless symbols and unit productions in a grammar ?

Eliminate unit productions for the following CFG :

$$G: E \rightarrow E + T \mid T$$

$$T \rightarrow T * F \mid F$$

$$F \rightarrow (E) \mid I$$

$$I \rightarrow a \mid b \mid Ia \mid Ib \mid I0 \mid I1$$

Attempt any **one** part :

1 × 10 = 10

- (a) Prove that “Language L has a PDA that accepts it by final state if L has a PDA that accepts it by empty stack”.
- (b) Find equivalent CFG of the following given PDA :

$$\text{PDA } P = ( \{q_0, q_1\}, \{a, b\}, \{a, Z_0\}, \delta, q_0, Z_0 )$$

Where  $\delta$  :

$$\delta ( q_0, a, Z_0 ) = ( q_0, aZ_0 )$$

$$\delta ( q_0, a, a ) = ( q_1, aa )$$

$$\delta ( q_1, a, a ) = ( q_1, \epsilon )$$

$$\delta ( q_1, \epsilon, Z_0 ) = ( q_1, \epsilon )$$

7. Attempt any two parts :

2 × 5 = 10

- (a) State Post Correspondence Problem and prove that "PCP is undecidable".
- (b) Design transition diagram for the language  $L = \{a^i b^j c^k \mid i, j > 0 \text{ and } k = i * j\}$  using Turing Machine.
- (c) Prove that "Every language defined by a regular expression is also defined by a finite automation".